

## CLAIMS

1. A method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group III element by vapor phase epitaxy, comprising the step of  
5 reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce a halogenated product of Al.
2. A method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group  
10 III element by vapor phase epitaxy, comprising the steps of reacting a solid mixture of group III metals including Al with a halogenated hydrogen at a temperature of 700°C or below to produce a halogenated product of Al and a halogenated product of a group III metal other than Al.
- 15 3. The method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group III element by vapor phase epitaxy according to claims 1 through 2, wherein the halogenated hydrogen is hydrogen chloride, hydrogen bromide, or hydrogen iodide.
- 20 4. A method for producing an Al-containing III-V group compound semiconductor by repeating a vapor phase epitaxial growth process to deposit layers of III-V group compound semiconductors of different compositions containing Al as a group III element, the method comprising a first step of  
25 reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce an halogenated product of Al; and a second step of reacting the halogenated

product of Al produced in the first step with a gas containing a group V element at a temperature of 700°C or above on the surface of a substrate crystal so as to grow a III-V group compound semiconductor on the substrate crystal, wherein at least one of the amount of the halogenated hydrogen used in the first step; the amount of a carrier gas for the halogenated hydrogen used in the first step; and the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions.

5. A method for producing an Al-containing III-V group compound semiconductor by repeating a vapor phase epitaxial growth process to deposit layers of III-V group compound semiconductors of different compositions containing Al as a group III element, the method comprising a first step of reacting a solid mixture of group III metals including Al with a halogenated hydrogen at a temperature of 700°C or below to produce a halogenated product of Al; and a second step of reacting the halogenated product of Al and the halogenated product of group III metals other than Al produced in the first step with a gas containing a group V element at a temperature of 700°C or above on the surface of a substrate crystal so as to grow a III-V group compound semiconductor on the substrate crystal in the vapor phase, wherein at least one of the amount of the halogenated hydrogen used in the first step; the amount of a carrier gas for the halogenated hydrogen used in the first step; and the

amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions.

6. The method for producing an Al-containing III-V group compound semiconductor according to claims 4 through 5, wherein the halogenated hydrogen is hydrogen chloride, hydrogen bromide, or hydrogen iodide, and the carrier gas for the halogenated hydrogen is hydrogen, an inert gas, or a mixture of hydrogen and an inert gas.

7. An apparatus for producing an Al-containing III-V group compound semiconductor by growing its crystal by hydride vapor phase epitaxy; the apparatus including a first reaction zone maintained at a temperature of 700°C or below; and a second reaction zone maintained at a temperature of 700°C to 1300°C.

8. The apparatus for producing an Al-containing III-V group compound semiconductor according to claim 7, wherein the first reaction zone includes support means for supporting a solid Al or a solid mixture of group III metals including Al, introduction means for introducing an halogenated hydrogen, and introduction means for introducing a carrier gas for the halogenated hydrogen; the second reaction zone includes support means for supporting a seed crystal substrate, introduction means for introducing the halogenated products produced in the first reaction zone, and introduction means for introducing a gas containing a group V element.

9. The apparatus for producing an Al-containing III-V group compound semiconductor according to claims 7 through 8, wherein a halogenated product of Al or a solid mixture of group III metals including Al is produced in the reaction in  
5 the first reaction zone, and a III-V group compound semiconductor is grown on the seed crystal substrate by vapor phase epitaxy in the reaction in the second reaction zone.

10. The apparatus for producing an Al-containing III-V group compound semiconductor according to claims 8 through 9,  
10 comprising:

a quartz reaction tube, within which the first reaction zone and the second reaction zone are arranged adjacent to one another;

15 first heating means arranged at a position of the quartz reaction tube corresponding to the first reaction zone; and

second heating means arranged at a position of the quartz reaction tube corresponding to the second reaction  
20 zone;

wherein the halogenated product produced in the first reaction zone is carried by the flow of the gas introduced into the first reaction zone to the second reaction zone.

11. The apparatus for producing an Al-containing III-V  
25 group compound semiconductor according to claims 8 through 10, wherein the halogenated hydrogen is hydrogen chloride, hydrogen bromide, or hydrogen iodide, and the carrier gas

for the halogenated hydrogen is hydrogen, an inert gas, or a mixture of hydrogen and an inert gas.